

Interactive comment on “Blowing snow detection from ground-based ceilometers: application to East Antarctica” by Alexandra Gossart et al.

Anonymous Referee #3

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Summary

This manuscript presents a new algorithm to identify blowing snow in clear-sky as well as during precipitation (not possible for satellite-based estimation) in Antarctica using vertical profiles of backscatter coefficient values from ceilometers. The depth of the blowing snow layer can also be estimated. The algorithm is first described and evaluated by comparison with collocated human observations collected at the Neumayer III station over several years. Given the satisfactory performance, the method is then applied to another data set collected at the Princess Elizabeth station. Statistics about the occurrence and depth of the blowing snow layers are derived, and the links with local meteorological conditions as well as weather regimes are investigated. These analy-

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ses reveal that the time to the last precipitation event is a key factor for the occurrence and depth of blowing snow layers.

Recommendation

This manuscript presents an original algorithm that will be useful to increase the pool of data to better understand the occurrence and dynamics of blowing snow. The study of the links between blowing snow occurrence and depth with meteorological conditions is interesting and provide new perspectives on the main factors controlling those features of blowing snow. The data and methods are well described and seem solid, although the evaluation could be based on more robust criteria and the details of the algorithm should be better illustrated. I hence recommend to send the manuscript back to the authors for moderate revisions. I have some comments and suggestions, listed below.

General comments

1. The evaluation of the performance of the detection algorithm is based on the comparison with human observations at Neumayer III. The different classes (occurrence or not) may be unbalanced (much more cases without blowing snow than with, as suggested on l.14, p.13) requires more robust statistics than the one used. There is a lot of literature about what criteria can be employed for such confusion matrices. See for instance *Allouche et al. (2006)*. I suggest the authors to use such commonly used statistics (e.g. Cohen's kappa, true skill statistics) for the evaluation of the algorithm. The estimated depth is not really evaluated, what would be needed to do so?
2. The statistics derived from the outcome of the blowing snow detection algorithm

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are informative and relevant, but they could be more complete, by including data and analysis about the inter- and intra-event variability of the blowing snow occurrence and depth.

Specific comments

1. P.7, l.28: the choice of smoothing the signal over 1 h should be better justified (why 1 h and not 30 min or 2 h?). The typical variability of the BS layer features should be commented (if there is a lot of dynamics within 1 h, one may lose relevant information by smoothing over 1 h).
2. P.8, l.1: "SNR higher than 0.3": I guess it is expressed in dB. If so, it should be clearly mentioned.
3. P.10, Fig.5: I probably missed something, but I do not understand why the backscatter signal from BS+precip is so much smaller (below 100 m alt) than the one from BS only (red vs blue). I would expect the two signals to sum up somehow... Or is the concentration in BS particles much smaller when there is precip? If so, what could be the explanations?
4. P.10, l.19: related question: it is written "The precipitation intensity might cover the blowing snow signal", which I find confusing with the curves in Fig.5 (for the lower altitudes). To be clarified...
5. P.11, l.6-7: about the estimation of the top of the BS layer: it would help the reader to indicate in Fig.5 where is this limit. And how reliable would be the outcome in case of virgas?
6. P.12, l.7-14: better metrics could be computed to evaluate the performance of the algorithm, see General comments above.

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7. P.14, l.3: Which statistical tests have been used to check if there are "statistically significant differences"?
8. P.15, l.16: a minimum of description should be provided about the clustering method employed, so the reader does not have to check the reference to know what type of clustering method has been used for instance...
9. P.16, Fig.10: the font size of the text in the figure should be increased.
10. P.16, l.14: I do not understand why the number of observations would decrease... The ceilometer is collecting data every 15s, no? The explanation should be clarified.
11. P.18, Fig.13: are these distributions for the two stations (Neumayer and PE) or only one location?
12. P.18, l.17: "commission errors" is repeated twice.
13. P.19, l.9: I guess the same algorithm could be applied to lidar systems, no?

References

Allouche, O., A. Tsoar, and R. Kadmon (2006), Assessing the accuracy of species distribution models: prevalence, kappa and the true skill statistic (tss), *J. Anim. Ecol.*, 43(6), 1223–1232.

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